

# Star and Planet Formation

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- What sets the stellar-substellar mass function and how universal is it?
- Do all stars form planets and if not, why not? What causes the diversity of planetary systems?
- What are the characteristics of exosolar planets?

Alycia J. Weinberger - Carnegie DTM  
COPAG Workshop, 9/23/2011

# Is IMF truly universal and why its shape?

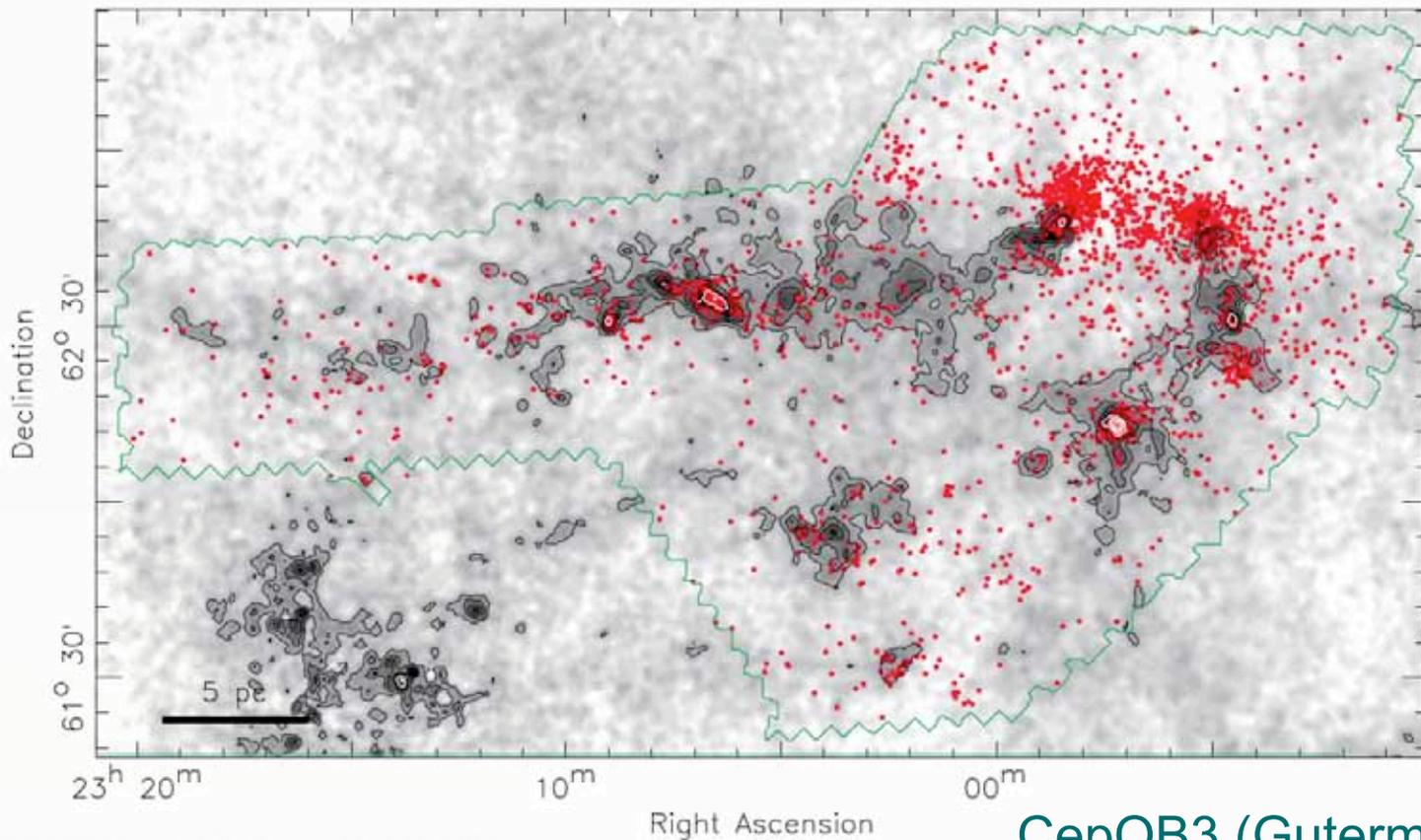
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- Why are massive stars rare?
- How does massive star feedback affect young stars?
- What determines whether a young cluster survives as an open cluster or disperses?

Feigelson et al. Astro2010 White Paper

# IMF To Do:

- Crowded Galactic Planes (need  $<0.2''$  resolution)
- Compare stars and gas (X-ray to far-IR)
- Study feedback (UV and X-ray)



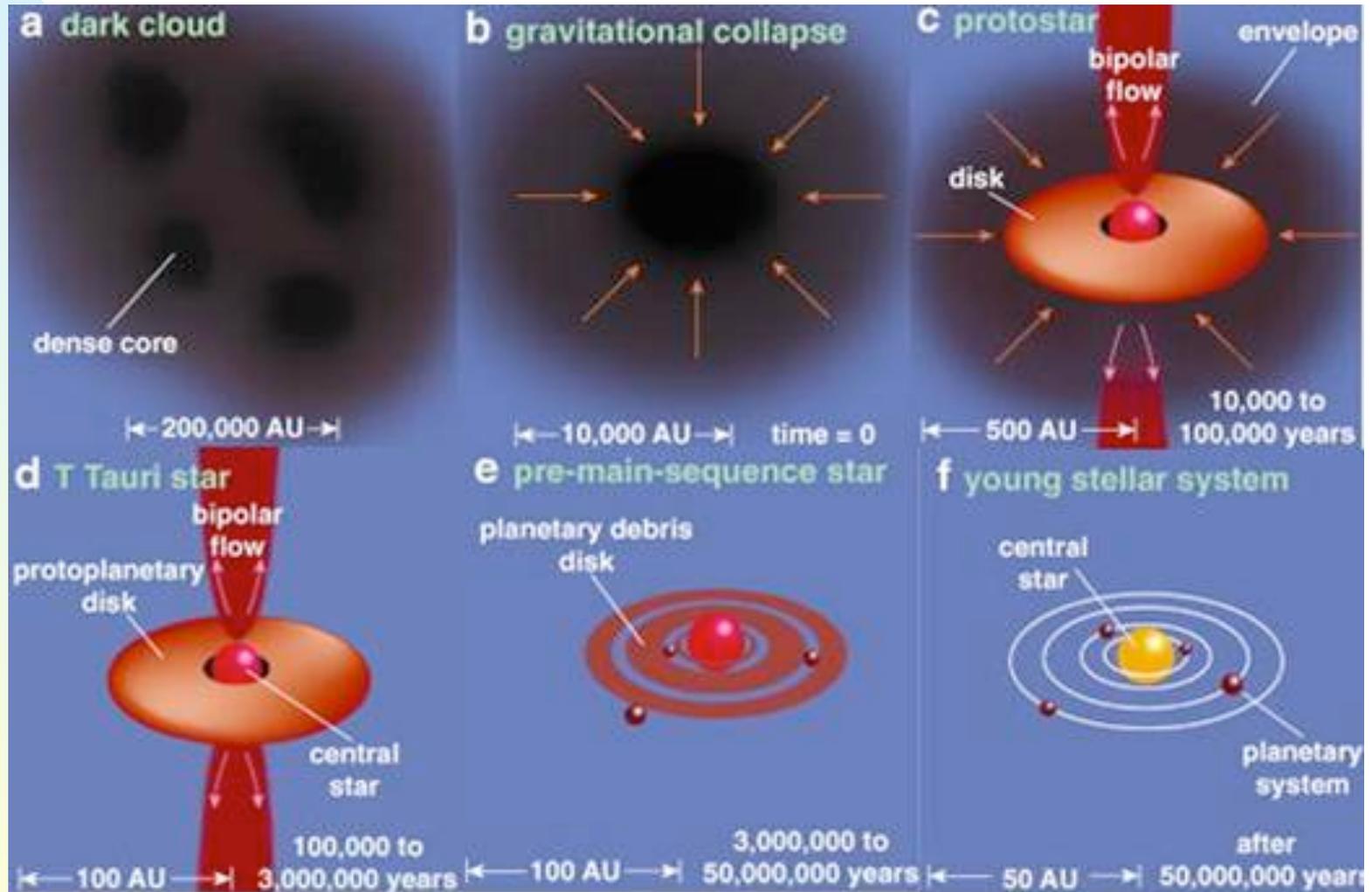
# Pre-Main Sequence Stars and Disks

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Evolution of the stars (episodic accretion, winds, stellar activity) affect protoplanetary disk mass, structure, chemistry, and evolution

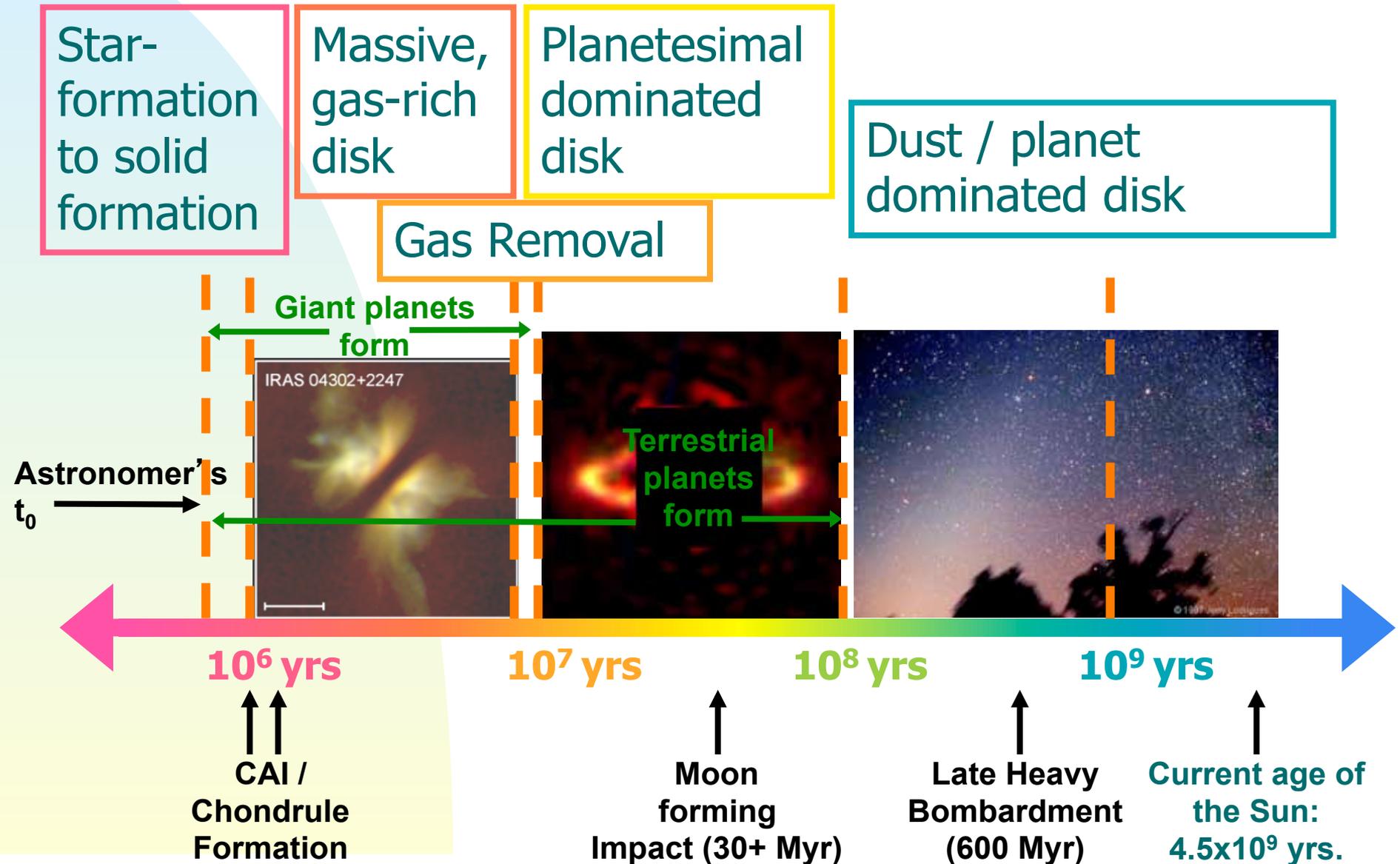
Goal: Measure what star is doing and what the disk response is

# Stellar and Disk Co-Evolution



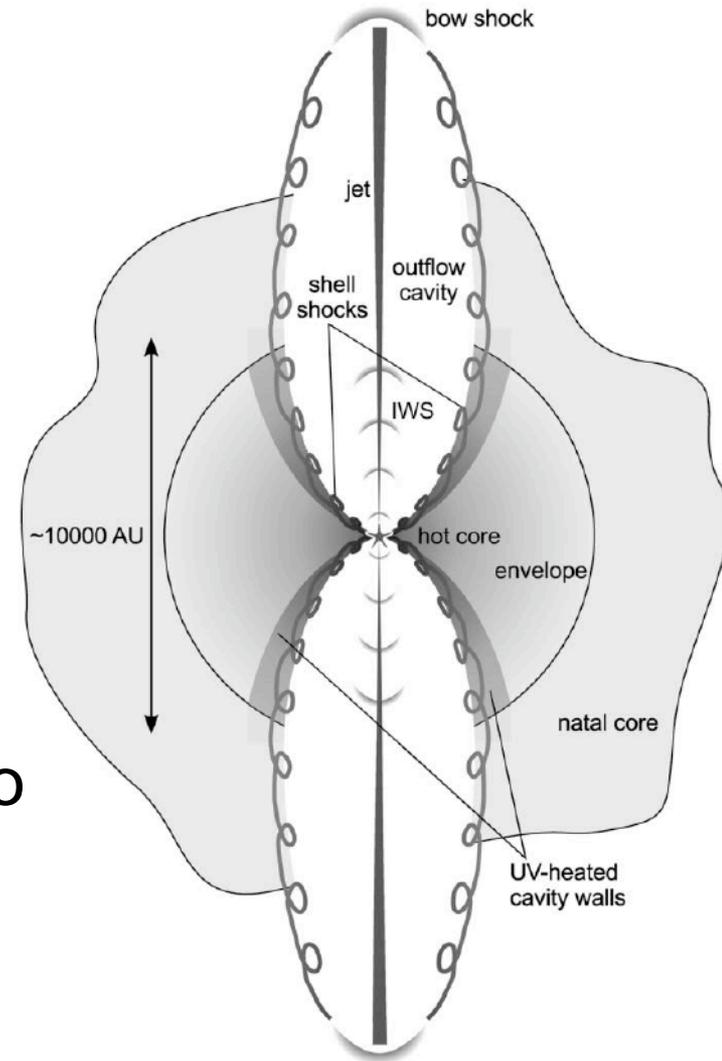
(Tom Greene)

# Planetary Formation Timescales



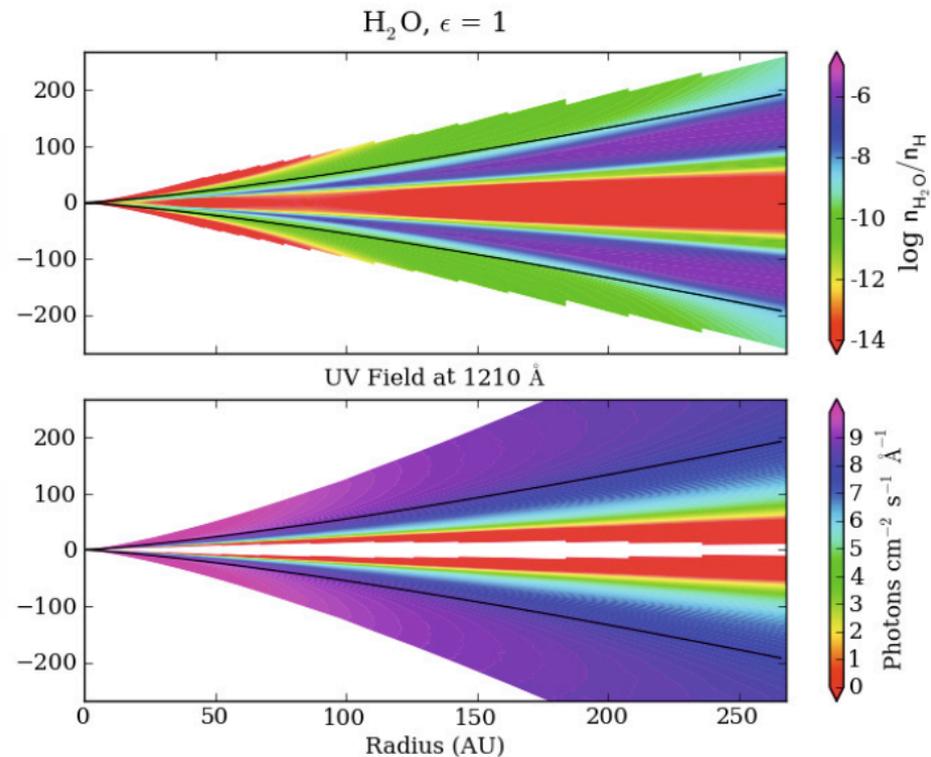
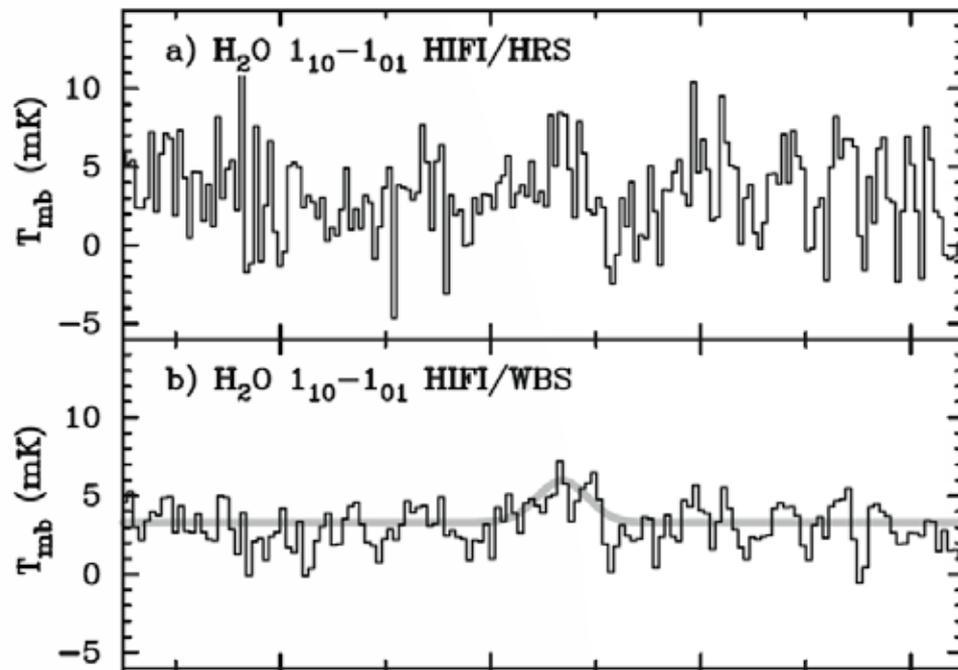
# To Do: Disk / Envelope Chemistry

- X-ray and UV spectroscopy of magnetic activity and disk interaction
  - ◆ Disk chemistry depends on ionizing fluxes
  - ◆ Measure molecules at higher sensitivity, larger wavelength regions, and higher spatial resolution than Herschel (species, e.g. HD, not visible to ALMA)



# To Do: Disk Chemistry, continued.

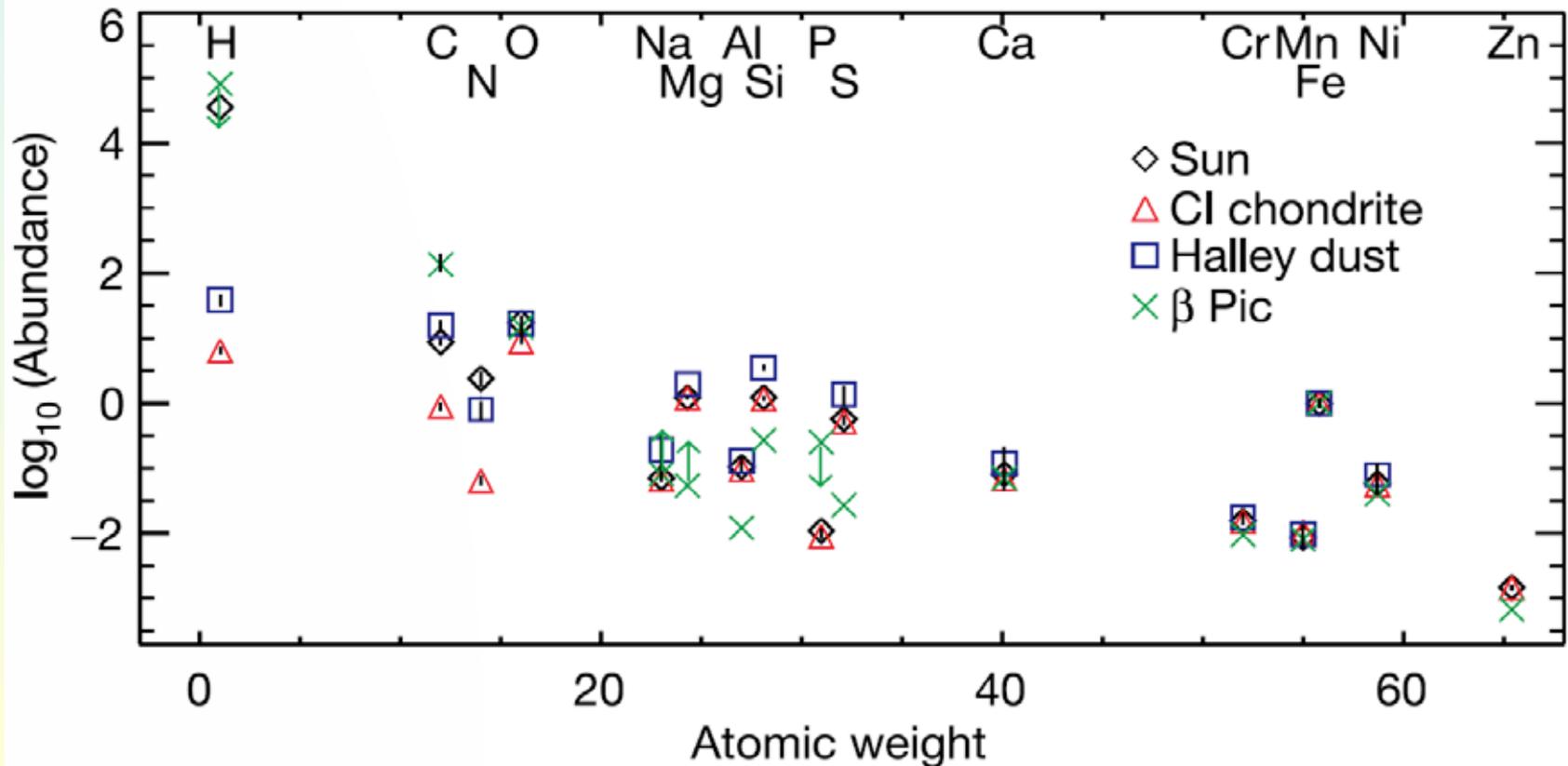
Example: Interplay of stellar UV and disk chemistry – amount of water desorbed from icy grains in disk surface



DM Tau, Bergin et al. 2010

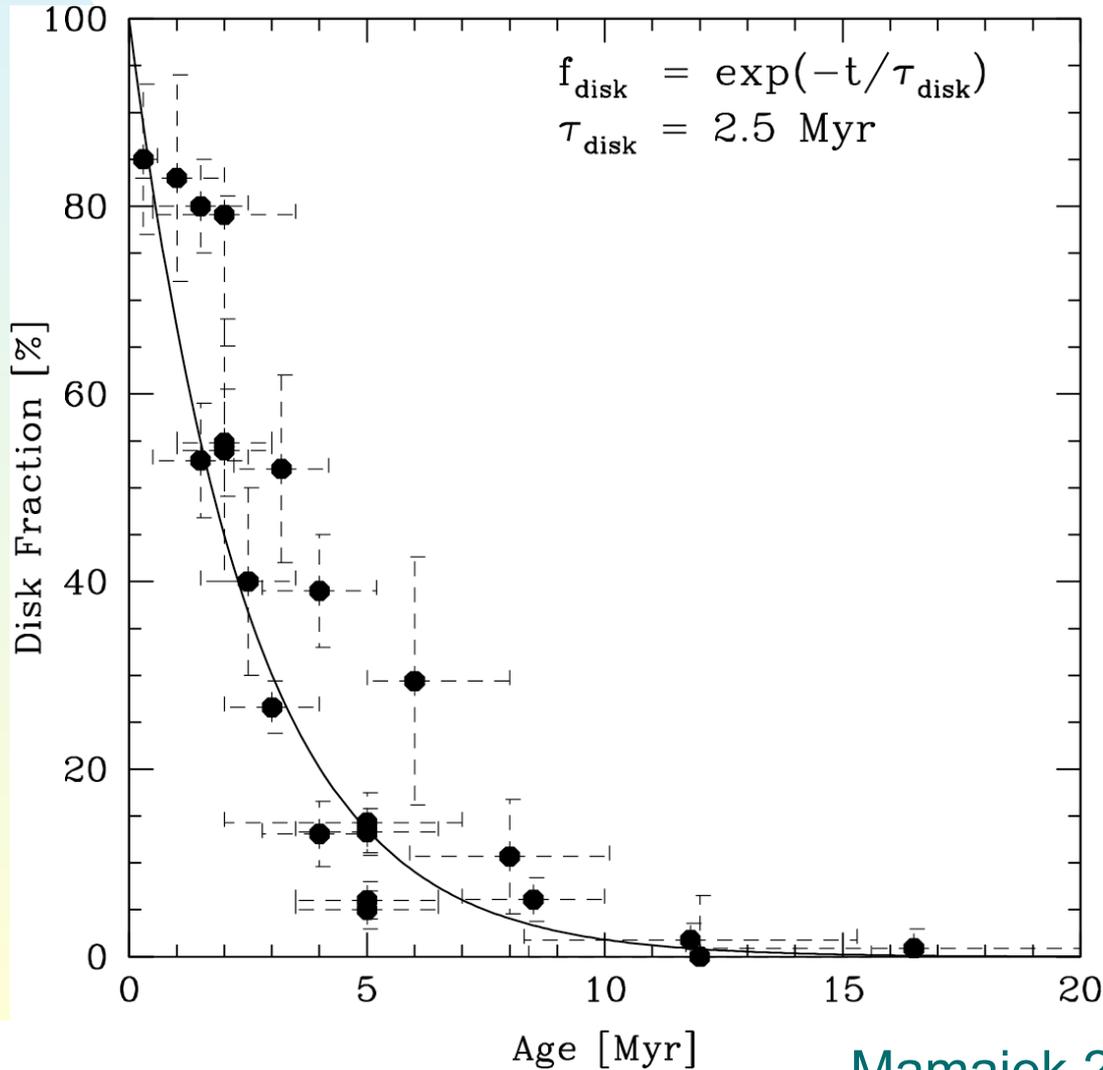
# To Do: Disk Chemistry (debris)

- FUV electronic transitions of atoms are strong, so even small amounts of gas can be detected in absorption.



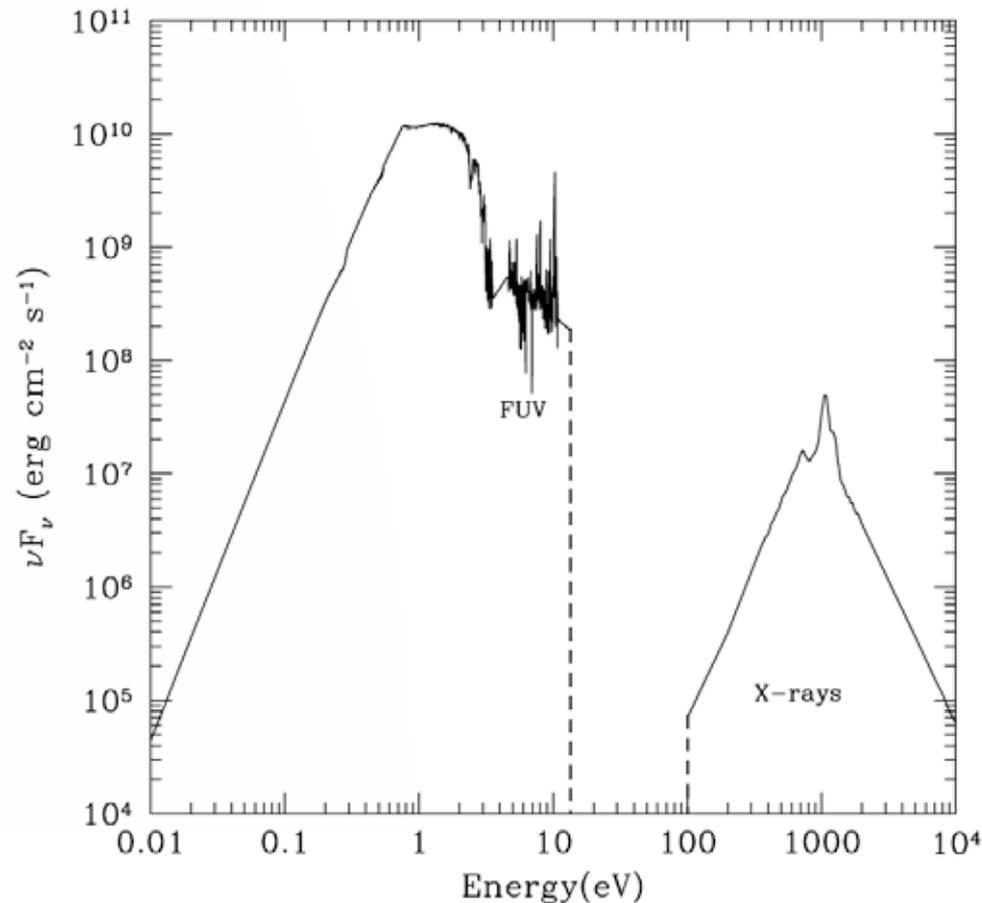
# Disk Dissipation

- Why do disks go away?



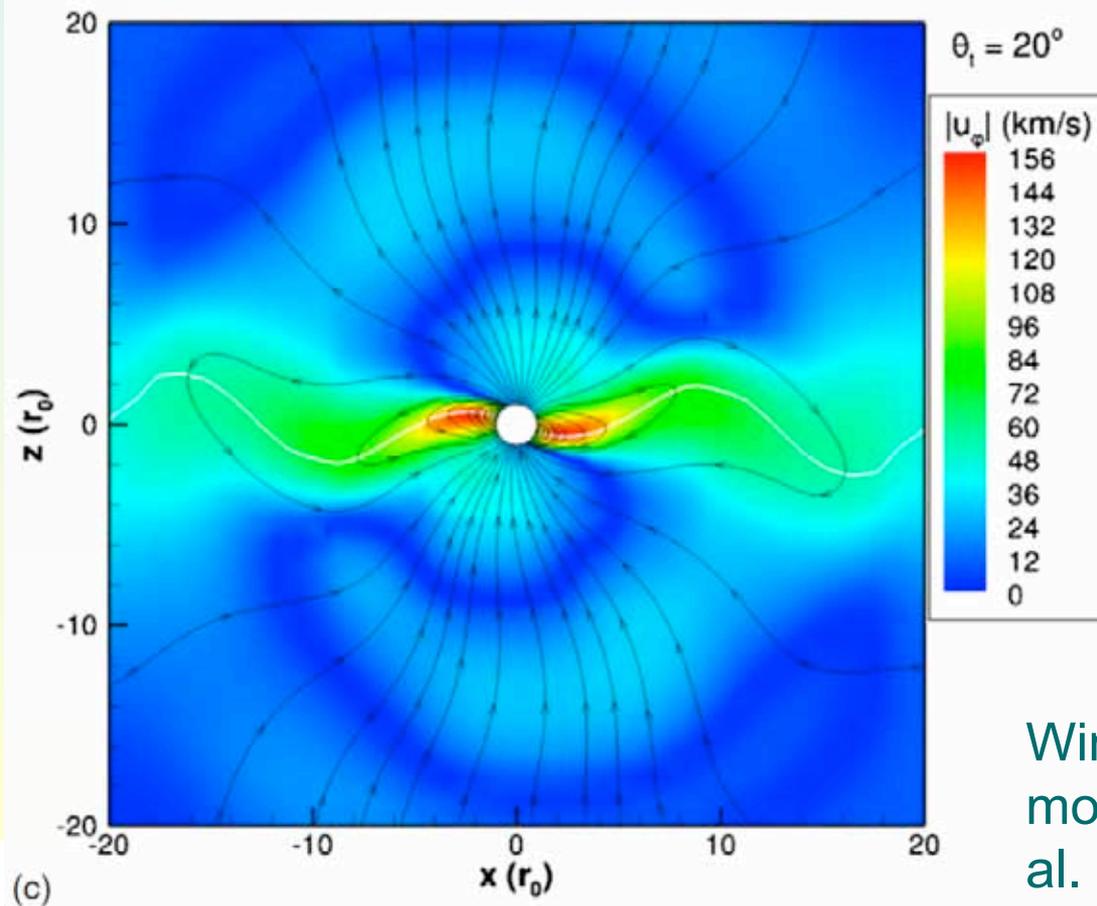
# Disk Dissipation: Photoevaporation

- So energetic photons from the star and/or accretion impact the disk chemistry and existence, but what is their spectrum?



# Star – Disk Interaction, continued

- Magnetized stellar wind depends on field intensity and topology. This wind hits disk.



Wind velocities from models of Vidotto et al. 2010

# **Disks: How to make, compose and possibly destroy planets**

- Substantial mismatch between predicted and observed distribution of exoplanets
- Major uncertainties:
  - ◆ How do gas-giant planets form.
  - ◆ How much do planets migrate.
  - ◆ Are there many habitable (water, etc) planets.

**All of these depend on disk structure and chemistry over time!**